# ENGG1500 Assessment 2 Title Page

**This document must be typed. Do not print it then fill in by hand!**

Student number: c3339952

Discipline: Medical engineering

Workshop class: Workshop number / Day / Time

W01/ Wednesday./8am – 10am/

Your workshop number can be found by googling ENGG1500, getting the 2020 online timetable and finding your class

Team number: N/A

How many hours did this assignment take: 10 hours approximately.

What mark would you honestly give yourself: 8 /10

Putting a low mark here will not negatively affect your mark

# Compliance

| | |
|---|---|
| *Staple in the top left hand corner (or bound)* | |
| *UoN coversheet attached to hard copy after this page. Try googling UoN cover page* | |
| *Font is 12 point Times New Roman* | |
| *Online submission made by 3pm Monday week 5 to **BB** as a .docx with the correct naming convention* | |
| *Online submission is identical to this report* | |
| *Submitted as a hard copy to the workshop leader **before** 5 min past the beginning of your week 5 workshop* | |

# Do not put your name anywhere on this document.

## INTRODUCTION

Welcome to Introduction to Engineering ENGG1500 and to our team. The purpose of this report is to bring you up to speed on course content over the first four weeks, paying specific attention to those learning experiences which will be of most assistance in our final group project and the construction of our three lead electrocardiogram (ECG). This report will outline the core concepts delivered in lectures so far, the practical skills developed in workshops and the associated code work relevant to the course and to our final project. Detailed information about course content can be found on Blackboard in the lecture notes and workshop slides, some of which will be referenced here, so please familiarise yourself with this platform and feel free to clarify any queries with your fellow teammates.

## GROUP PROJECT

### Scope

Our ECG device must achieve the following:

- Have no negative health effects on any patient.
- Safe for anyone to operate to the point if someone with no prior knowledge is being trained to use the device they cannot hurt themselves.
- Do what an ECG does and that is convert and display the electricity signals of the heart into a readable beat per minute figure (BPM**)**

### Constraints

This device must:

- Work on any person no matter their height or weight.
- Be portable and be self-powered with out interfering with the device’s readings.

- Be comfortable when worn by a patient.
- The device will need to be encased so all delicate parts and wiring will no get damaged in day to day use and moving around of the object.
- Be user friendly as hospital staff use an ECG in times of crisis and it is crucial that it can be easily used in a rush without complications.

## THEORY

One of the most important concepts to understand in the study of engineering is that the term 'engineer' does not refer so much to a job description but to a mindset; that of following an innate curiosity to know the 'why' and 'how'[1]. Engineers approach any challenge by thinking outside of the box and use a combination of technology and innovation to address problems and create new solutions. The upcoming ECG project will be the first opportunity we have to test drive this new mindset as a team and, even though the device itself is rather simplistic, it is our first foray into engineering and our first step in shaping the future.

### Assumptions and Modelling

In order to hypothesize about engineering scenarios, we need to account for possible complications. One way to do this is by creating mathematical models based on known and quantifiable assumptions such as projectile motion, drag, friction, velocity, gravity and classical laws of physics. Assumptions and models are closely linked and, although they give an incomplete picture, they are useful tools in engineering [2]. As we work towards our group project, we need to be sure to take these concepts into account and consider how they might affect our design. This leads to our next topic, that of understanding how engineers measure and explain the world around us. In order to ensure consistency, accuracy and reproducibility, the International System of Units uses seven units of measurements to define and calculate

our understanding of life [3]. We should always consider whether or not we are correctly applying the appropriate unit of measurement into our theories and ideas as well as recording it in our results. As engineers we use models to investigate an engineering problem, and our assumptions aid us in simplifying those models so we can create a solution in a low risk and low cost environment. We can test this solution against our engineering problem and have reliable results at the end which will help us when building the real thing to scale. When building our ECG, it will be imperative to make as minimal assumptions as possible, considering that peoples lives can depend on the accuracy of these devices. In order to minimise the risk to the public we must consider everything from how large our unit is, how many wires are included, what materials are used and how those materials act on humans.

**Research**

There is a huge difference between good research and bad research, between evidence and hypothesis, and it is essential that we understand this difference and can support our findings with confidence [4]. Part of the learning process will be to start in simple places to find basic ideas or examples and slowly work up to more advanced explanations and concepts. We will require a considerable amount of detailed research for our project and the quality of this endeavour will form the backbone of our work as we move through the following engineering stages.

**Engineering Stages**

At this point we know we need to think about the world around us, how we measure it and how to locate and evaluate available information, so that we are ready to engage in the engineering process, which includes:

- Problem identification
- Scoping the problem
- Research
- Potential solutions [5]

**PRACTICAL**

At the commencement of this course we were all given a kit, see Figure 1, consisting of the main component Arduino Uno R3 board. So far, our main tasks have been to join the Arduino together and attaching its infrared sensor (IR) to detect dark or light surfaces.

Figure 1 (original kit) referring to Week 1

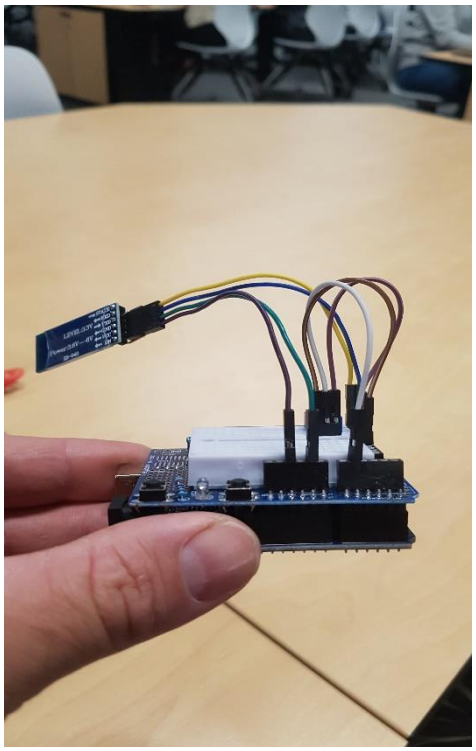

Figure 2 (connected Bluetooth) referring to Week 2

We then built basic circuits to get a light emitting diode (LED) to light up and attached the Bluetooth master and slave modules to the unit, see Figure 2, as we will be working off Bluetooth from here on in.

Finally, we connected the potentiometer and coded it to create an analog signal which can be digitally read. This will be a crucial function later when we want to measure the electrical activity of the heart and translate that data into a readable format. See Figure 3 for a close-up top view of the current status of our Arduino after the third lab was complete.

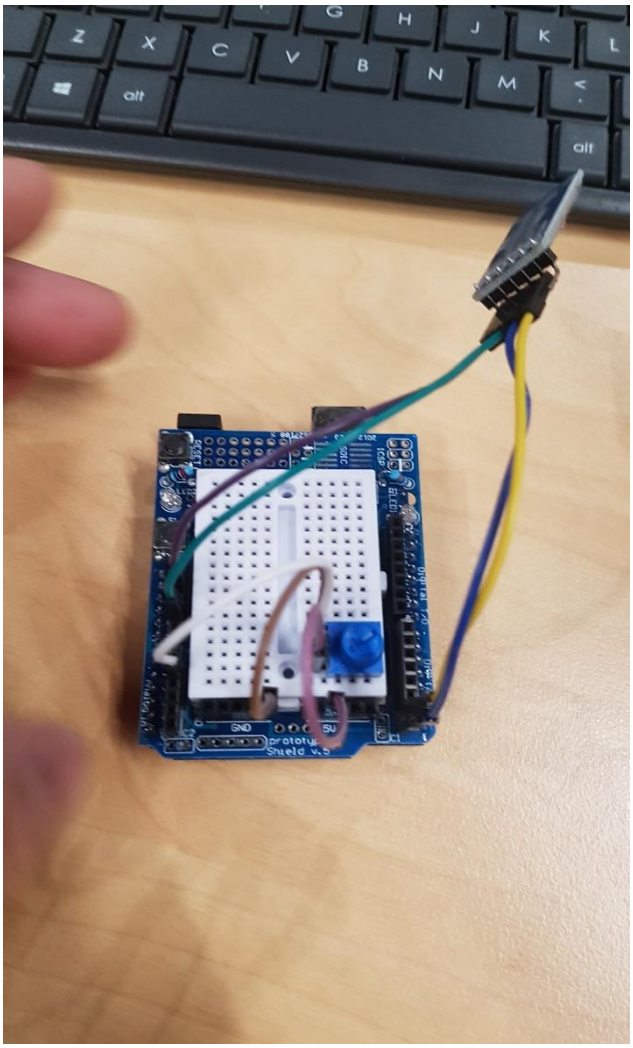

Figure 3 Arduino current state at the of end of Lab 3

**Coding the Arduino**

This current project is heavy on coding and putting in the work to be up to date with your skills is paramount. So far, we have applied all the basic knowledge you would have learned in SENG1110 such as using functions, loops and declaring variables. We are currently focused on learning any Arduino specific syntax functions that will aid us in getting this project to work. Some examples of these are pinMode inputs and outputs, analogWrite, analogRead functions, digitalWrite, digitalRead function [6]. Researching and understanding these functions is required as we move forward so we can clearly plan our logic and not waste time working out which function is required. Later in the project it will be crucial to consolidate our coding and functions to be as concise and accurate as possible, as we will

have limited processing power to compute complicated systems, eg. an accurate way of calculating beats per minute (BPM).

**Practical Competency**

The most recent task was to get your Arduino to display a heart rate on the screen. We connected AD8232 heart monitor sensor, see Figure 4, with the electrodes, see Figure 5.

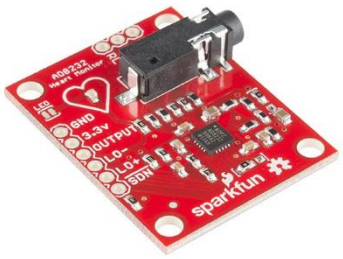


Figure 4

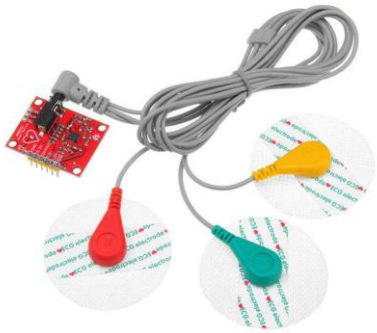

Figure 5

This is connected to the Arduino unit and the electrodes were place on our team member Tom. After working out our code we concluded the heart needs to be read through the input pin and read with the analog read function then we need to print that reading to the screen using the print function. This allowed us to display the heart rate on the screen. We found you will need to play around with the placement of electrodes on the body in order to get the correct combination of locations for the reading to work.

**Learning from Lab Lessons**

The most important thing about the labs/workshops is the lessons taken away from each one and understanding how they can improve you understanding of what is going on and building on the skillset and mindset required to become a successful engineer.

**Lab 1 Lessons**

As a team so far, we have learnt understanding coding is easier if you treat it as a participation sport and if you do not want to practice regularly you will not get better. Getting a grasp on the Arduino code, such as digitalWrite functions delays, loops, getting a sensor to perform required task, understanding the loop function and knowing when and how to break it was crucial.

**Lab 2 Lessons**

Correct circuit connection had to be made, this were you need to follow basic instructions no matter your current knowledge of what you are doing, Connecting the Bluetooth had to be done correctly on the first attempt or damage may occur to the unit with overheating. We accomplished this by realising sometimes it is better to act like you are a blank sheet of paper, step back and just absorb the instructions you are given. This skill will translate into the real world in that if you make mistakes not following simple instructions this will impact a projects time, money, resources and potential client confidence in you getting the job done.

Always conduct testing on a new component to make sure connectivity and code is doing as we intend it to.

**Lab 3 Lessons**

Lab three is where our team is starting to click and gel as a unit. We had a good amount of coding logic to work out between us, this was broken into understanding what we want the Arduino to do and what syntax is required to make it do.  Firstly, as engineers, it is important to manage lab\workshop time correctly and efficiently. Secondly, developing as a team is crucial to ensure all tasks including extension tasks are completed within the timeframe to a high level. You are about to join a great team of aspiring engineers and working through new concepts and solving those problems means being patient, honest, prompt, reliable, leaving

your ego at the door and keeping an open minded before you sit down because we are all wrong a lot of the time. By following these values, our team is succeeding and improving every day.

**Lab 4 Lessons**

This was a competency lab to see how your coding skills are and the main lesson was once you have completed the task you may get a huge skew in your data results and a large negative spike. This was due to the sensor pads on our device picking up interference.

From electric and magnetic fields our data changed depending on where we were in the room, standing further from the device in the room or by power running through the roof or underneath the floor. Later in the course we will be told how to control this interference and what measures can be put in place to minimise any interference.

## CONCLUSION

Looking back at the last few weeks of this course it is already starting to show how important medical engineering has become and how vital it will be in the future. It is defiantly an exciting time to get involved. I understand that our device will need better design choices and further streamlining to become useful in the industry, but, even after just a few weeks of this course, I can that we have the potential to change the world for the better.

## REFERENCES


[1] M. Brojak, “Engineering: mindset, not a profession!”, Apr. 29, 2016. [Online]. Available: https://www.rs-online.com/designspark/engineering-mindset-not-a-profession. [Accessed Mar. 16, 2020].

[2] D. Cuskelly. ENGG1500. Class Lecture, Week 2. University of Newcastle, New South Wales, Mar. 2, 2020.

[3] Wikipedia, “International System of Units”, 2020. [Online]. Available: https://simple.wikipedia.org/wiki/International_System_of_Units. [Accessed Mar. 16, 2020].

[4] M. Q. McShane, “Good Research vs Bad Research”, Feb. 10, 2014. Available: https://www.edchoice.org/engage/good-research-vs-bad-research/. [Accessed Mar. 18, 2020]

[5] D. Cuskelly. ENGG1500. Class Lecture, Week 3. University of Newcastle, New South Wales, Mar. 9, 2020.

[6] Arduino, “Language Reference”, 2020. [Online]. Available: https://www.arduino.cc/reference/en/. [Accessed Mar.19, 2020].